PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-017628
(43)Date of publication of application : 25.01.1994

(51)Int.Cl. F01L 13/00
F01L 1/04

(21)Application number : 04-177928
(22)Date of filing : 06.07.1992

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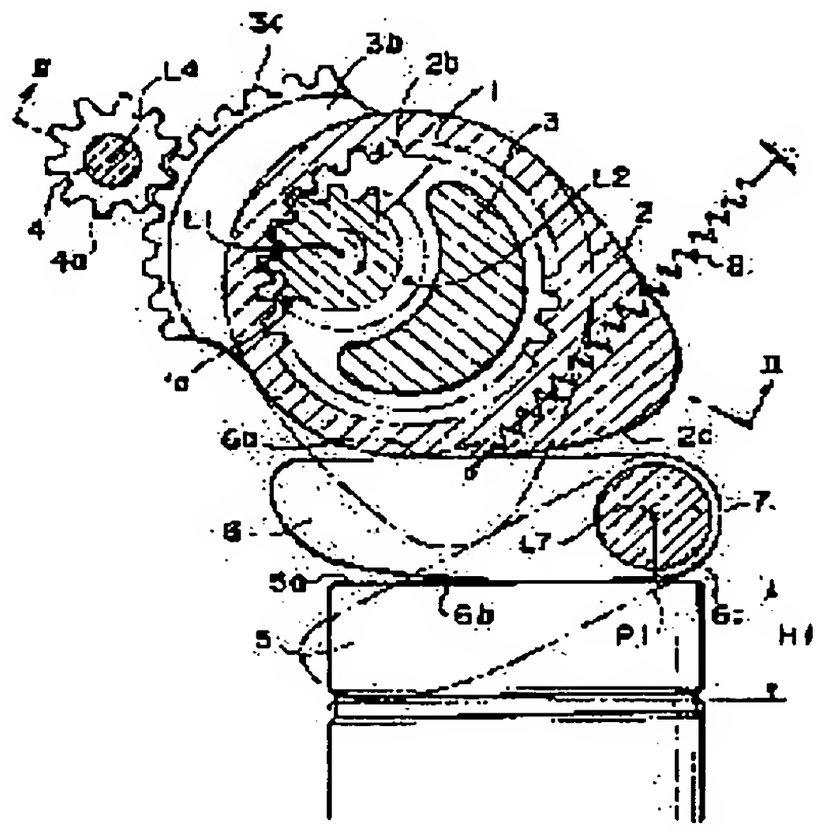
(54) VARIABLE VALVE TIMING DEVICE OF ENGINE

(57)Abstract:
PURPOSE: To obtain a variable valve timing device of an engine which is capable of simultaneously and continuously changing the valve opening angle, the valve lift amount, and the phase of the cam relative to the cam shaft.
CONSTITUTION: A variable valve timing device is provided with a cam 2 in a relatively rotatable and eccentric manner relative to a cam shaft 1, and at the same time, provided with an intermediate member 3 to execute the relative rotation of the cam 2 around the cam shaft 1, and an oscillating arm 6 which is energized in the direction facing toward the cam by a spring 8, and is constantly abutted the cam 2. The relative rotation of the cam 2 around the cam shaft 1 by the intermediate member 3 allows the continuous change of the phase of the cam 2 relative to the cam shaft 1 and the relative position of the cam 2 to the valve.



LEGAL STATUS

[Date of request for examination]	18.05.1999
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3330640
[Date of registration]	19.07.2002
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] the cam shaft by which revolution actuation is carried out synchronizing with a revolution of an engine crankshaft, and this cam shaft -- receiving -- relativity -- by carrying out relative rotation of the cam prepared rotatable and this cam around said cam shaft The adjustable device in which the phase of the cam to said cam shaft and the relative position to the bulb of this cam can be changed continuously, It is prepared free [a splash] around an axis parallel to said cam shaft, and it is energized by said cam in the direction of the other side with an energization means, and is rocked always in contact with this cam. Valve timing adjustable equipment of the engine characterized by coming to have the swinging arm which transmits the bulb closing motion driving force from said cam to said bulb with this splash.
[Claim 2] Valve timing adjustable equipment of the engine according to claim 1 characterized by coming to have the pars intermedia material supported to revolve by said cam shaft after said cam carried out eccentricity, and was prepared to said cam shaft and said adjustable device had supported said cam to revolve free [rotation], and the actuator made to rotate this medium member around said cam shaft with said cam.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the valve timing adjustable equipment of the engine which carries out adjustable [of ** and the exhaust air bulb closing motion timing].
[0002]
[Description of the Prior Art] Generally, since changing according to engine operational status is desirable as for the closing motion timing of ** in the engine of an automobile, and an exhaust air bulb, various valve timing adjustable equipments are proposed conventionally.
[0003] For example, the valve-timing control unit of the engine which consists of a manual operating device which makes JP,59-188014,A by application of these people rotate the tappet which has the press section which transmits the force from the pressure-receiving section and the above-mentioned cam side receive the force from the cam side of a cam shaft to a valve stem, the rotation member which has the fit-in hole which fits in this tappet free [sliding], and was supported free [a revolution] around the cam shaft, and this rotation member according to engine operational status is indicated.
[0004] With this equipment, the above-mentioned rotation member by being held in the engine standard location the sliding direction of a tappet and whose motion direction of a bulb correspond at least at the time of a heavy load high revolution When a skid does not arise between a tappet and a valve stem but the above-mentioned rotation member rotates from a standard location at the time of a low-speed revolution A skid arises between a tappet and a valve stem, and it is constituted so that valve timing may be changed by this between the times of a low-speed revolution and a high-speed revolution.
[0005] moreover, with the valve timing adjustable equipment indicated by JP,3-115714,A The main rocker arm which the cam for low speeds and the cam for high speeds are installed by the cam shaft, and engages with the both sides of the above-mentioned cam for low speeds, and a bulb, While the subrocker arm which engages only with the above-mentioned cam for high speeds adjoins mutually and is prepared in the rocker shaft free [a splash] By engaging and releasing of the pin which can move in the direction of an axis of the above-mentioned rocker shaft with oil pressure, the above-mentioned Lord, The change-over device which can switch a subrocker arm to a interlocking condition or the condition of not interlocking, alternatively is arranged. At the time of high-speed operation of an engine By combining the above-mentioned Lord and a subrocker arm by the above-mentioned pin, it considers as a interlocking condition and the above-mentioned bulb drives by the cam for high speeds. At the time of engine low r.p.m. operation The above-mentioned Lord and a subrocker arm being used as the condition of not interlocking, it is constituted so that the above-mentioned bulb may drive by the cam for low speeds.
[0006]
[Problem(s) to be Solved by the Invention] By the way, with the configuration indicated by the former, i.e., JP,59-188014,A, at the time of a high-speed revolution of an engine with a high bulb actuation rate, since the skid between a tappet and a valve stem does not arise, even if wear of a valve stem and a tappet decreases and a skid arises between a tappet and a valve stem at the time of a low-speed revolution of an engine, since the bulb actuation rate is low, it has the outstanding effectiveness that wear of a valve stem and a tappet decreases too.
[0007] However, with this configuration, it was that valve timing is only delayable with the skid between a tappet and a valve stem, for example, since a principle top was impossible, it was what it is hard to attach to the object which is going to raise the maximum output substantially in a heavy load high revolution region to perform simultaneously the tooth lead angle of valve-opening timing and the angle of delay of clausilium timing, and to extend a valve-opening angle.

[0008] On the other hand with the structure indicated by the latter, i.e., JP,3-115714,A It becomes possible to choose in independent the valve-lift property which suited an engine low revolution region and an engine high revolution region, respectively. The components mark of what can achieve the expected improvement in the engine performance increase and it not only needs a special cam shaft and a complicated oil path, but Since there is a possibility that it may be accompanied by the impact and shearing stress moreover acted on the pin for engaging and releasing when switching the Lord and a subrocker arm between a interlocking condition and the condition of not interlocking, the problem was in the endurance of a pin.
[0009] Furthermore, it was what is not obtained depending on the conventional configuration to make it it not only to only to increase a valve-opening angle and the amount of valve lifts rather than a light load region, but change from a light load region to such a valve-lift property continuously toward a high revolution heavy load region, although it is known that it is advantageous to expand the field by the side of closing of a bulb rather than an aperture side when raising the charging efficiency of inhalation of air in the heavy load high revolution region.
[0010] This invention aims at offering the valve timing adjustable equipment of the engine to which the phase of the cam to a valve-opening angle, the amount of valve lifts, and a cam shaft can be changed that it is simultaneous and continuously in view of such a technical problem.
[0011]
[Means for Solving the Problem] the valve timing adjustable equipment of the engine by this invention -- a cam -- a cam shaft -- receiving -- relativity -- while being prepared rotatable, it is characterized by having the adjustable device in which relative rotation of this cam is carried out around a cam shaft, and the swinging arm which is energized by the cam in the direction of the other side with an energization means, and always contacts a cam. And when relative rotation of the above-mentioned cam is carried out by the above-mentioned adjustable device around a cam shaft, it is constituted so that the phase to the cam shaft of a cam and the relative position to the bulb of a cam may be changed continuously, and the above-mentioned swinging arm has the function to transmit the bulb closing motion driving force from a cam to a bulb, with the splash.
[0012] According to one mode of this invention, to the cam shaft, the cam carried out eccentricity, and was prepared, and it has the pars intermedia material by which the above-mentioned adjustable device was interposed between the cam shaft and the cam, and the actuator made to rotate this pars intermedia material around a cam shaft with a cam, and the above-mentioned pars intermedia material is supported to revolve by the cam chateau where the above-mentioned cam is supported to revolve free [rotation].
[0013]
[Function and Effect] according to this invention -- a cam shaft -- receiving -- relativity -- by carrying out relative rotation of the cam prepared rotatable and this cam around a cam shaft By having the swinging arm which intervenes between the adjustable device in which the phase of the cam to a cam shaft and the relative position to the bulb of a cam can be changed continuously, and a cam and a bulb According to engine operational status, the phase to the cam shaft of a cam it not only being made to change continuously but it is effective in the ability to obtain the valve timing adjustable equipment which can also change continuously it, simultaneously the valve-opening angle and the amount of lifts of a cam with high dependability.
[0014]
[Example] Hereafter, the example of this invention is explained based on a drawing.
[0015] Drawing 1 is drawing showing the fundamental configuration of the valve timing adjustable equipment of the engine by this invention. In addition, drawing 1 is the II-II. I-I of drawing 2 which is the sectional view which met the line It is shown as a sectional view which met the line. Moreover, drawing 3 is III-III of drawing 2 . It is the sectional view which met the line.
[0016] In drawing 1 - drawing 3 , the cam shaft 1 by which revolution actuation is carried out by an engine crankshaft carrying out a revolution synchronization is supported to revolve by the engine cylinder head free [a revolution], and it is parallel to that axis of rotation L1, and the cam 2 which has the axis of rotation L2 which only the predetermined distance D left carries out eccentricity to a cam shaft 1, and it is prepared in this cam shaft 1.
[0017] The cam 2 is equipped with feed-hole 2a which consists of a circular hole centering on that axis of rotation L2, and the cam shaft 1 has penetrated the inside of this feed-hole 2a. The cam shaft 1 and the cam 2 are maintaining mutual physical relationship by the pars intermedia material 3 which intervenes among both.
[0018] The pars intermedia material 3 is equipped with body 3a which is supported to revolve with the mode

made to penetrate a cam shaft 1, enabling a free revolution by the cam shaft 1, and is prepared in the surroundings of the axis of rotation L1 of a cam shaft 1 rotatable, and fits into feed-hole 2a of a cam 2, and is supporting the cam 2 to revolve with the surroundings of that axis L2 free [a revolution] by this body 3a.
[0019] Except for the part into which body 3a of the above-mentioned pars intermedia material 3 has fitted, the perimeter is covered and internal-gear 2b is formed in the inner skin of feed-hole 2a of a cam 2. Moreover, in the peripheral face of a cam shaft 1, external-tooth gearing 1a which carries out inscribed engagement is formed in internal-gear 2b of the above-mentioned cam 2, and both gearings 1a and 2b constitute the differential gear. Moreover, the cam shaft 1 and the cam 2 also constitute the reducer style which sets a reduction gear ratio to 2 by setting the gear ratio of external-tooth gearing 1a of a cam shaft 1, and internal-gear 2b of a cam 2 as 1:2. Therefore, the cam pulley attached in the end of a cam shaft 1 is formed in the crank pulley and the diameter of said of a crankshaft which carry out revolution actuation through this, a timing belt, etc.
[0020] Itabe 3b which projects with the axis-of-rotation L2 side of a cam 2 about a cam shaft 1 in the pars intermedia material 3 in an opposite hand is prepared in one. This Itabe 3b is equipped with the end face which makes the circular face centering on the axis of rotation L1 of a cam shaft 1, and external-tooth gearing 3c is formed along with this end face.
[0021] In order to rotate the above-mentioned pars intermedia material 3, the shaft 4 which has the axis of rotation L4 parallel to the above-mentioned axis of rotation L1 and L2 is formed, and external-tooth gearing 4a which gears to the peripheral face of this shaft 4 at external-tooth gearing 3c of the above-mentioned pars intermedia material 3 is formed. If a shaft 4 is rotated with an actuator like a step motor and a shaft 4 rotates, as shown in drawing 4 While it rotates centering on a cam shaft 1 while the pars intermedia material 3 had supported the cam 2 to revolve, and a cam 2 rotates relatively to a cam shaft 1 in connection with this and the phase to the cam shaft 1 of a cam 2 is changed The axis of rotation L2 of a cam 2 moves up and down in a centering on axis of rotation L1 of cam shaft 1 radii top, and it is constituted so that the relative position to the bulb of a cam 2 may also be changed.
[0022] On the other hand, although the rushes adjuster (HLA) 5 of the bucket mold which has flat top-face 5a is formed between the bulbs and cams 2 in which closing motion actuation is carried out by the above-mentioned cam 2, the swinging arm 6 which is rocked by the cam 2 and transmits the driving force from a cam 2 to a bulb through the rushes adjuster 5 is further formed between this rushes adjuster 5.
[0023] It is fixed to the shaft 7 which has the axis of rotation L7 parallel to the axis of rotation L1 of a cam shaft 1, and the swinging arm 6 is formed free [a splash]. This swinging arm 6 An underside side is equipped with contact side 6b which makes the gently-sloping curved surface which equips a top-face side with flat contact side 6a which always contacts cam side 2c of a cam 2, and always contacts top-face 5a of the rushes adjuster 5. By and Spring-8 It is energized in the clockwise rotation of drawing 1 , i.e., the direction which it contacts by pressing on cam side 2c of a cam 2. Moreover, the surroundings of a shaft 7 are equipped with circular face 6c centering on the axis of rotation L7 of that shaft 7, and it is formed in the swinging arm 6 so that circular face 6c of a parenthesis may follow contact side 6b to top-face 5a of the rushes adjuster 5 in a point P1.
[0024] Next, actuation of the equipment shown in drawing 1 - drawing 4 is explained.
[0025] Now, the condition that the axis of rotation L2 of a cam 2 exists on the flat surface containing the axes L1 and L4 of a cam shaft 1 and the shaft 4 for pars intermedia material rotation shall be considered, and a bulb shall have upper contact side 6a of a swinging arm 6 in a clausilium condition in contact with a part for the equal diameter cylinder surface part of cam side 2c of a cam 2 as shown in drawing 1 . And the swinging arm 6 shall be set up so that top-face 5a of the rushes adjuster 5 may be contacted in contact side 6b of the lower part.
[0026] When a cam shaft 1 rotates from this condition to the clockwise rotation of drawing 1 , a cam 2 is one half of cam shafts 1. The location (the maximum lift location of a bulb) which rotated clockwise with rotational speed and was shown with the chain line is reached, and a swinging arm 6 will be in the condition by which it went caudad from the level condition, was rocked greatly clockwise, and was shown with the chain line in connection with this.
[0027] With the splash of this swinging arm 6, it opens with a lift curve since it is depressed below, as a bulb indicated to be to the curve A of drawing 5 , and clausilium of the rushes adjuster 5 is carried out only for distance H1 by the rotation to the clockwise rotation of the continuing cam 2. The valve-lift property in this case serves as a large valve-opening angle and the amount of large lifts.
[0028] Next, if the shaft 4 for pars intermedia material rotation is clockwise rotated from the condition of drawing 1 and the pars intermedia material 3 is counterclockwise rotated centering on a cam shaft 1, while

the axis of rotation L2 of a cam 2 moves upwards with a cam 2, the tooth lead angle of the phase to the cam shaft 1 of a cam 2 will be carried out as shown in drawing 4 . And it rotates clockwise and the swinging arm 6 energized by Spring-8 toward cam side 2c is followed on this rotation, the contact side over the rushes adjuster 5 of the swinging arm 6 at the time of bulb clausilium passes a point P1 from on field 6b, and moves from it on circular face 6c, and will be in the condition of having contacted top-face 5a of the rushes adjuster 5 in the point P2 on circular face 6c.

[0029] Next, this condition to the cam shaft 1 reaches the location (the maximum lift location of a bulb) which rotated the cam 2 clockwise and was shown with the chain line when drawing 4 rotated clockwise, and it becomes the location which the swinging arm 6 was rocked counterclockwise and shown with the chain line in connection with this.

[0030] In this case, since the contact location to top-face 5a of the rushes adjuster 5 of the swinging arm 6 at the time of bulb clausilium suited the point P2 on circular face 6c as were shown in drawing 4 , and described above, From this condition, even if a swinging arm 6 is rocked counterclockwise, the contact location to top-face 5a of the rushes adjuster 5 of a swinging arm 6 in the early stages of a splash, a cam 2 does not act on the rushes adjuster 5 until it reaches a point P1 from a point P2 in a circular face 6c top -- it is clear. Similarly, in the time of bulb clausilium, a cam 2 will not act on the rushes adjuster 5 in the section until the contact location to top-face 5a of the rushes adjuster 5 of the splash member 6 results [from a point P1] in a point P2.

[0031] Moreover, since it is larger than the case where the distance between cam side 2a of a cam 2 and top-face 5a of the rushes adjuster 5 is drawing 1 , in this case, the distance H2 by which the rushes adjuster 5 is depressed below will become smaller than the distance H1 in drawing 1 . Therefore, as compared with Curve A, it becomes the property of **********, and the lift property of a bulb serves as the amount of small lifts from a small valve-opening angle as shown by the curve B of drawing 5 in this case.

[0032] Furthermore, since the tooth lead angle of the phase to the cam shaft 1 of a cam 2 is carried out rather than the condition by which the condition by which it was shown in drawing 4 was shown in drawing 1 , Curve B serves as a configuration biased to the left (the direction of a tooth lead angle) from Curve A. Therefore, if the valve-lift property of the intake valve in an engine light load region is set up like Curve B and the valve-lift property of the intake valve in a heavy load high revolution region is set up like Curve A, in a heavy load high revolution region, it becomes the ideal valve-lift property that the ****** inclination of an intake valve becomes remarkable, and the charging efficiency of inhalation of air can be raised so much. And in the configuration shown in drawing 1 - drawing 4 , there is an advantage which can attain property change continuously even in the property of Curve A from the property of Curve B by rotating the shaft 4 for pars intermedia material rotation with an actuator.

[0033] In addition, the configuration and the amount of lifts of Curves A and B of drawing 5 can be set as arbitration with the relative position to the profile of the cam side of a cam 2, the profile of contact side 6b of a swinging arm 6, the cam 2 of the shaft 7 which is the center of oscillation, and the both sides of the rushes adjuster 5 etc.

[0034] By the above explanation, although the configuration and its actuation of the valve timing adjustable equipment of the engine by this invention became clear, the example at the time of changing only the configuration of the swinging arm 6 of the above-mentioned equipment a little next, and applying to an engine is explained based on drawing 6 R> 6 and drawing 7 . In addition, in drawing 6 and drawing 7 , the same sign is attached to the member shown in drawing 1 - drawing 4 , and the member which has the same function.

[0035] The inspired air flow path cam shaft 1 is supported to revolve free [a revolution] by the cylinder head 10, and the cam 2 for intake valve actuation is attached in the cam shaft 1 of a parenthesis in the same mode as drawing 1 - drawing 4 .

[0036] One pair of intake valves 11 driven by the cam 2 are supported by the valve guide 12 free [sliding], and energization ** is carried out in the upper part of clausilium of drawing, i.e., the direction, with a valve spring 13, and the swinging arm 6 and the rushes adjuster 5 are formed between the cam 2 and the intake valve 11.

[0037] In the configuration shown in drawing 6 and drawing 7 , in order to make the whole height low One member 6A which the swinging arm 6 equipped with contact side 6a to a cam 2, 1 set is made by the members 6B and 6B of the couple equipped with contact side 6b to the rushes adjuster 5. The point that the above-mentioned members 6B, 6A, and 6B of each other are fixed to the cylinder head 10 through predetermined spacing by the shaft 7 supported to revolve free [rotation] is a different point from the configuration shown in drawing 1 - drawing 4 . And by ****(ing) Spring-8 between the heads of member

6A of a swinging arm 6 and the cylinder heads 10 which contact a cam 2, it consists of configurations shown in drawing 6 and drawing 7 so that member 6A may always contact a cam 2.

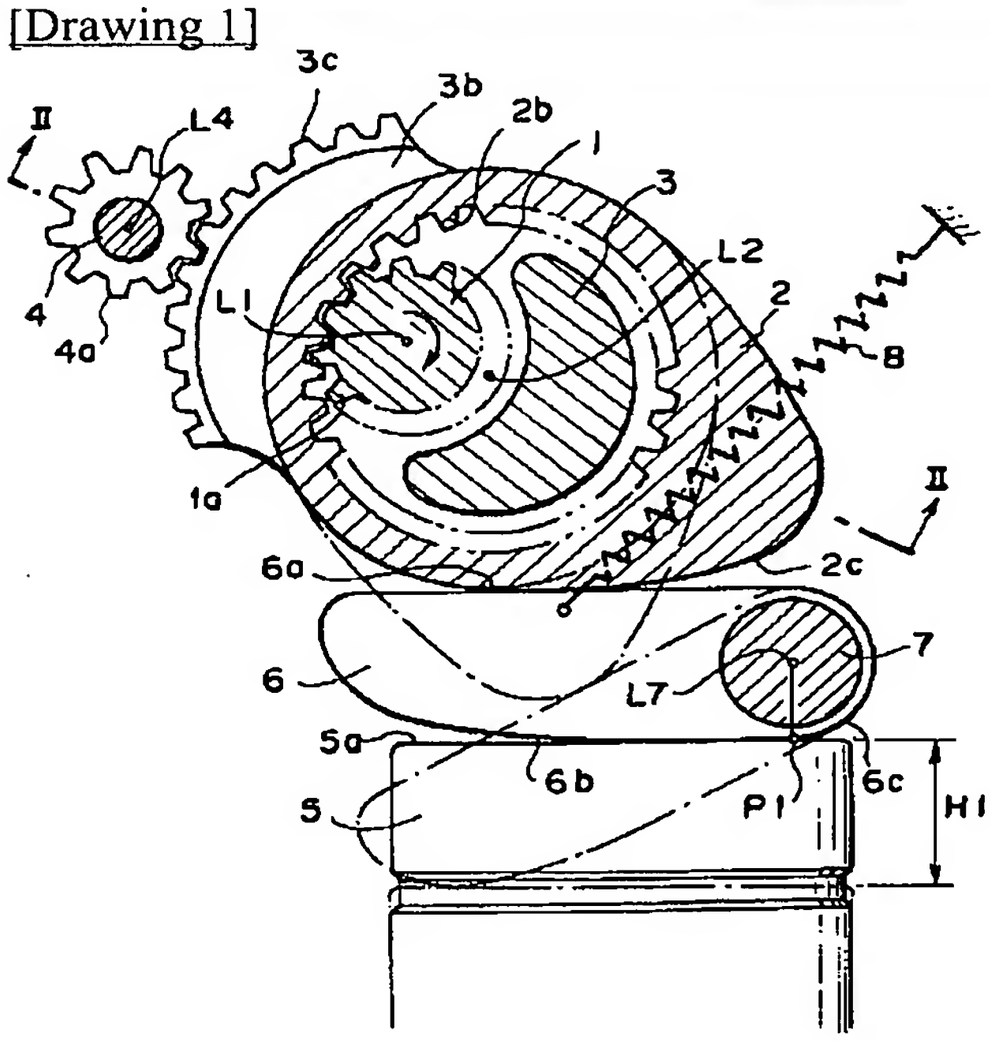
[Translation done.]

* NOTICES *

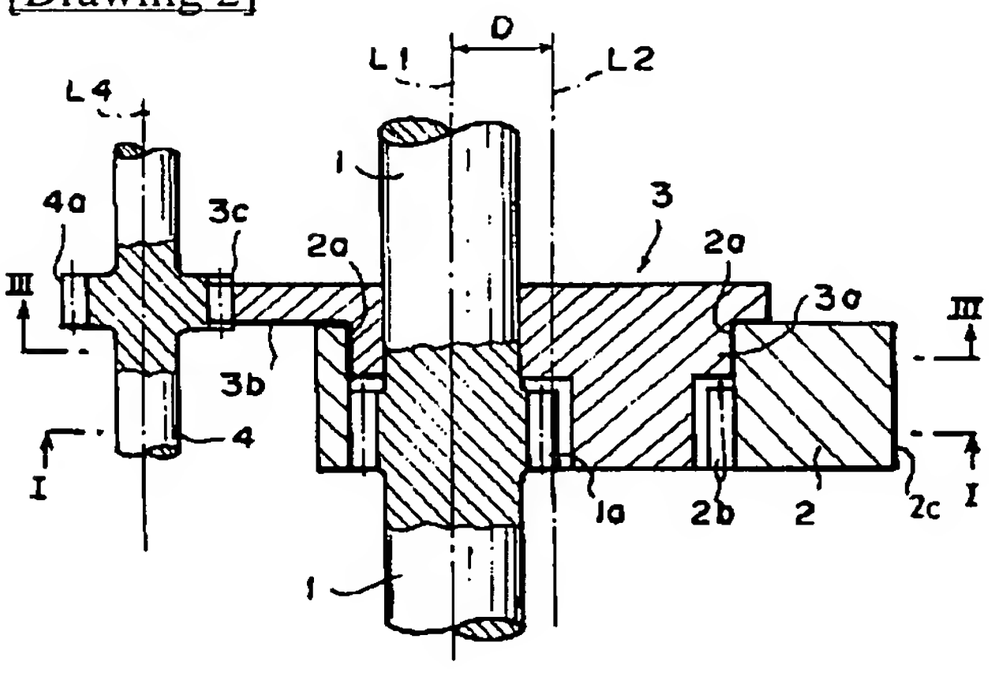
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

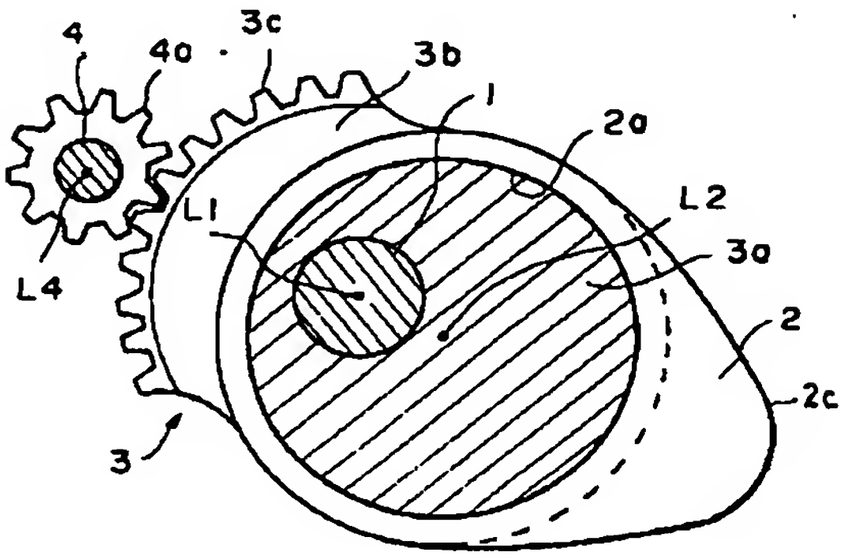
[Drawing 1]



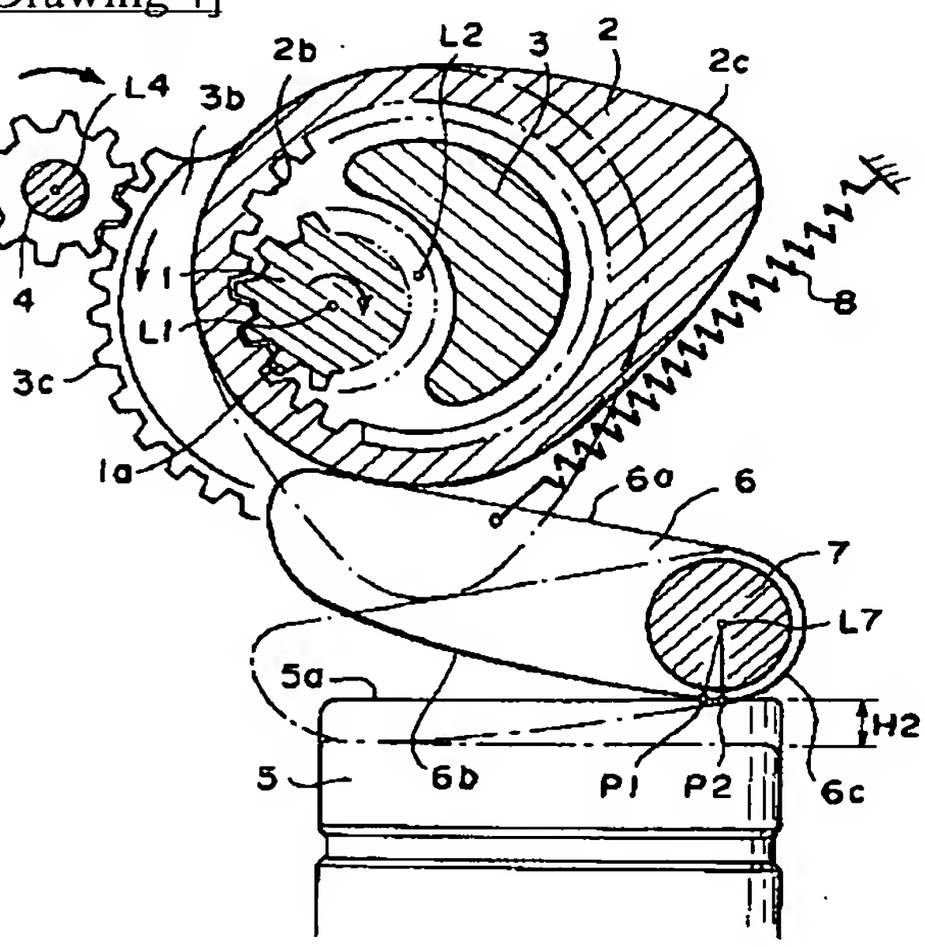
[Drawing 2]



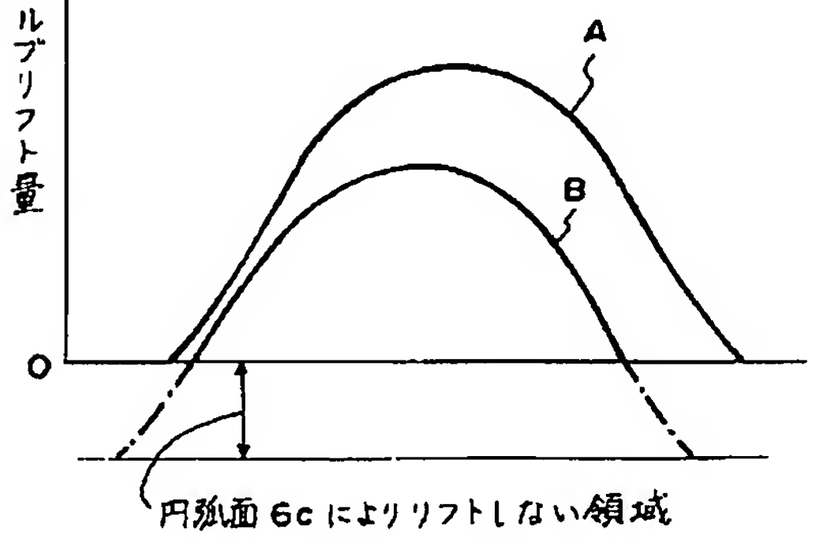
[Drawing 3]



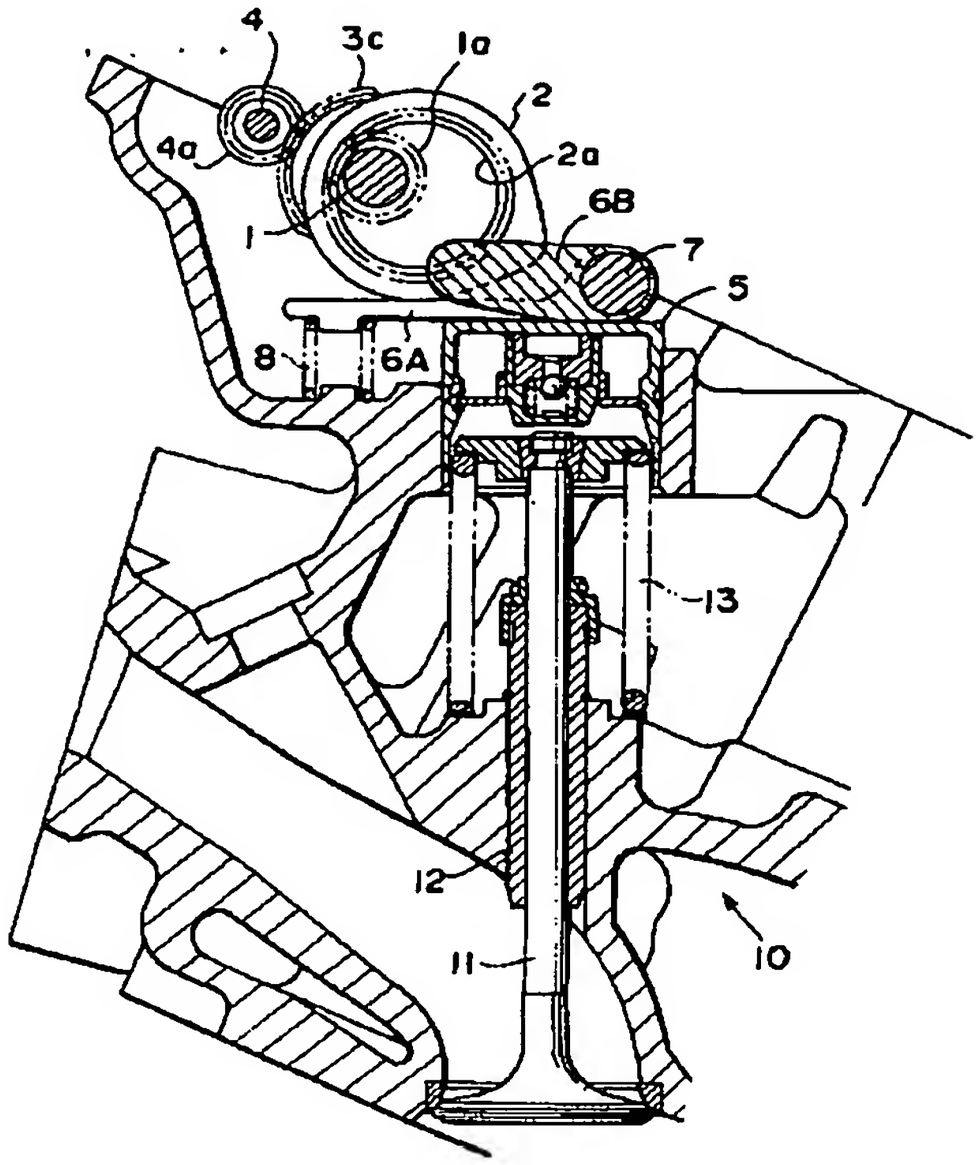
[Drawing 4]



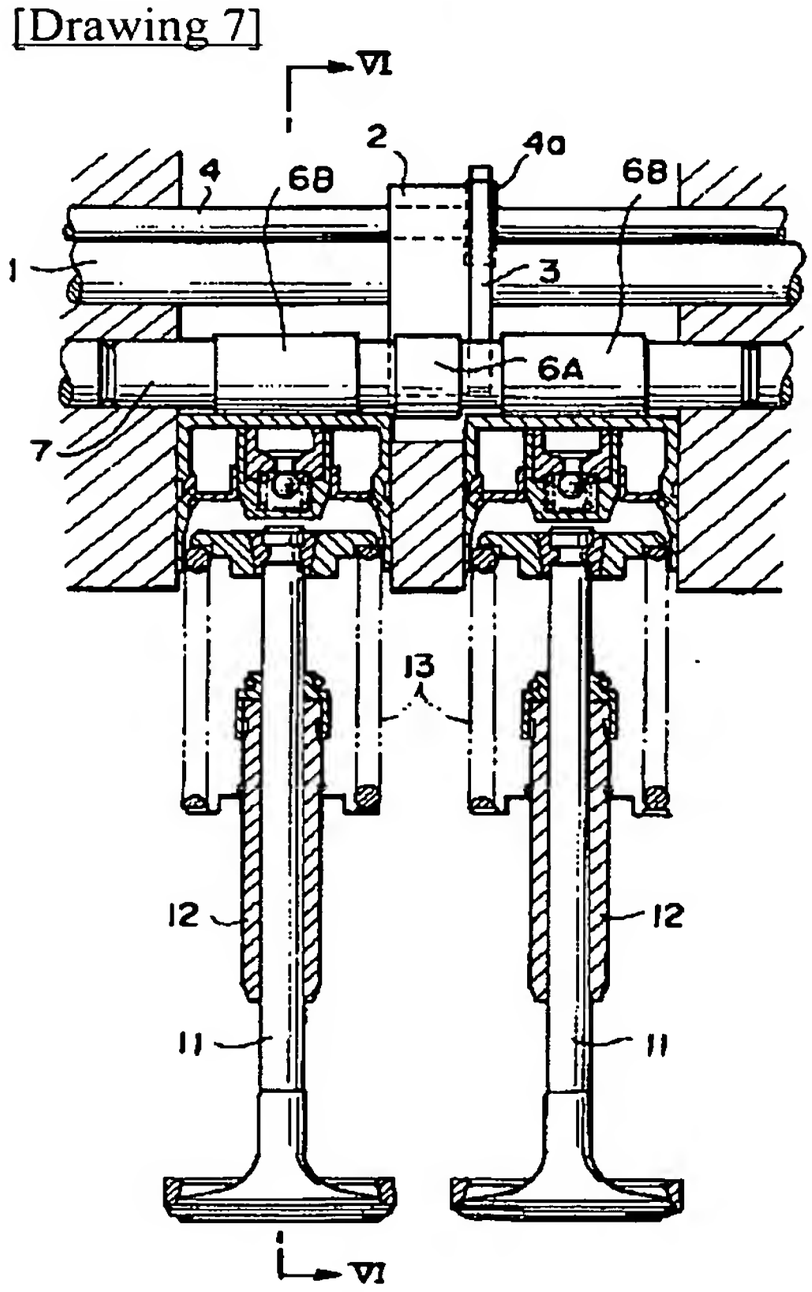
[Drawing 5]



[Drawing 6]



[Drawing 7]



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